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JOINT STRIKE FIGHTER

Restructuring Places Program on Firmer Footing, but Progress Is Still Lagging

Statement of Michael Sullivan, Director
Acquisition and Sourcing Management

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May 2011

JOINT STRIKE FIGHTER

Restructuring Places Program on Firmer Footing, but Progress Is Still Lagging

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Highlights

Highlights of GAO-11-677T, a testimony before the Committee on Armed Services, U.S. Senate

Why GAO Did This Study

The F-35 Lightning II, also known as the Joint Strike Fighter (JSF), is the Department of Defense's (DOD) most costly and ambitious aircraft acquisition, seeking to simultaneously develop and field three aircraft variants for the Air Force, Navy, Marine Corps, and eight international partners. The JSF is critical for recapitalizing tactical air forces and will require a long-term commitment to very large annual funding outlays. The estimated total investment cost is currently about $385 billion to develop and procure 2,457 aircraft. Because of a history of relatively poor cost and schedule outcomes, defense leadership over the past 15 months has directed a comprehensive restructuring of the JSF program that is continuing.

This testimony draws substantially from our extensive body of work on the JSF including our April 2011 report, the latest annual review mandated in the National Defense Authorization Act for Fiscal Year 2010, Pub. L. No. 111-84 § 244 (2009). This testimony discusses (1) program cost and schedule changes and their implications on affordability; (2) progress made during 2010; (3) design and manufacturing maturity; and (4) test plans and progress. GAO's work included analyses of a wide range of program documents and interviews with defense and contractor officials.

View GAO-11-677T or key components. For more information, contact Michael J. Sullivan at (202) 512-4841 or shiversc@gao.gov

What GAO Found

DOD continues to restructure the JSF program, taking positive, substantial actions that should lead to more achievable and predictable outcomes. Restructuring has consequences—higher up-front development costs, fewer aircraft in the near term, training delays, and extended times for testing and delivering capabilities to warfighters. Total development funding is now estimated at $56.4 billion to complete in 2018, a 26 percent cost increase and a 5-year schedule slip from the current baseline. DOD also reduced procurement quantities by 246 aircraft through 2016, but has not calculated the net effects of restructuring on total procurement costs nor approved a new baseline. Affordability for the U.S. and partners is challenged by a near doubling in average unit prices since program start and higher estimated life-cycle costs. Going forward, the JSF requires unprecedented funding levels in a period of more austere defense budgets.

The program had mixed success in 2010, achieving 6 of 12 major goals and progressing in varying degrees on the rest. Successes included the first flight of the carrier variant, award of a fixed-price aircraft procurement contract, and an accelerated pace in development flight tests that accomplished three times as many flights in 2010 as the previous 3 years combined. However, the program did not deliver as many aircraft to test and training sites as planned and made only a partial release of software capabilities. The short takeoff and landing (STOVL) variant had significant technical problems and deficient flight test performance. DOD directed a 2-year period to evaluate and engineer STOVL solutions.

After more than 9 years in development and 4 in production, the JSF program has not fully demonstrated that the aircraft design is stable, manufacturing processes are mature, and the system is reliable. Engineering drawings are still being released to the manufacturing floor and design changes continue at higher rates than desired. More changes are expected as testing accelerates. Test and production aircraft cost more and are taking longer to deliver than expected. Manufacturers are improving operations and implemented 8 of 20 recommendations from an expert panel, but have not yet demonstrated a capacity to efficiently produce at higher production rates. Substantial improvements in factory throughput and the global supply chain are needed.

Development testing is still early in demonstrating that aircraft will work as intended and meet warfighter requirements. About 4 percent of JSF capabilities have been completely verified by flight tests, lab results, or both. Only 3 of the extensive network of 32 ground test labs and simulation models are fully accredited to ensure the fidelity of results. Software development—essential for achieving about 80 percent of the JSF functionality—is significantly behind schedule as it enters its most challenging phase.

Chairman Levin, Ranking Member McCain, and Members of the Senate Armed Services Committee:

Thank you for the opportunity to discuss our work on the F-35 Lightning II, also known as the Joint Strike Fighter (JSF). The JSF is the Department of Defense's (DOD) most costly and ambitious aircraft acquisition, seeking to simultaneously develop and field three aircraft variants for the Air Force, Navy, Marine Corps, and eight international partners. DOD is acquiring the conventional takeoff and landing (CTOL) variant for the Air Force, the carrier variant (CV) for the Navy and Marine Corps, and the short takeoff and landing (STOVL) variant for the Marine Corps. The JSF is the core of DOD's long-term tactical aircraft recapitalization plans as it is intended to replace hundreds of legacy aircraft. Total planned U.S. investment in JSF is now about $385 billion to develop and acquire 2,457 aircraft through 2035. Acquisition costs are expected to rise when the department establishes a new approved program baseline next month.

With such a substantial funding commitment amidst pressing warfighter requirements for this next generation capability, DOD has lately recognized numerous technical, financial, and management shortcomings and announced a major restructuring of the JSF program in February 2010. In March 2010, the department declared that the program experienced a breach of the critical cost growth statutory threshold and subsequently certified to Congress in June 2010 that the JSF program should continue.[1] Appendix I summarizes the evolution of JSF cost and schedule estimates at key junctures in its acquisition history through the Nunn-McCurdy certification. Since then, in January 2011, the Secretary of Defense announced additional development cost increases and further changes consequent to the ongoing restructure.

[1] Commonly referred to as Nunn-McCurdy,10 U.S.C. § 2433 establishes the requirement for DOD to submit unit cost reports on major defense acquisition programs or designated major subprograms. Two measures are tracked against the current and original baseline estimates for a program: procurement unit cost (total procurement funds divided by the quantity of systems procured) and program acquisition unit cost (total funds for development, procurement, and system-specific military construction divided by the quantity of systems procured). If a program's procurement unit cost or acquisition unit cost increases by at least 25 percent over the current baseline estimate or at least 50 percent over the original baseline estimate, it constitutes a breach of the critical cost growth threshold. When a program experiences a Nunn-McCurdy breach of the critical cost growth threshold, DOD is required to take a number of steps, including reassessing the program and submitting a certification to Congress in order to continue the program, in accordance with 10 U.S.C. § 2433a.

GAO has reported on the JSF acquisition program for a number of years. We've identified serious and continuing problems, including escalating costs, deteriorating schedules, unsatisfactory performance in manufacturing and delivering aircraft, slow progress in testing, and concerns about not meeting warfighter requirements on time and in quantity. We issued our latest JSF report on April 7, 2011.[2] While we supported the thrust and rationale behind the department's restructuring actions, we continued to find generally slow progress across the program and serious affordability challenges, both in terms of the investment costs to acquire the JSF and the continuing costs to operate and support it over the life cycle. To sustain a focus on accountability and facilitate trade-offs within the JSF program, we recommended that DOD (1) maintain annual funding levels at current budgeted amounts; (2) establish criteria for evaluating the progress of the short takeoff and landing (STOVL) variant and make independent reviews, allowing each variant to proceed at its own pace; and (3) conduct an independent review of the software development and lab accreditation processes. DOD concurred with our recommendations, but this has not been the usual case. Appendix II summarizes key findings and recommendations in our body of work from 2001 through 2010 and the department's generally lukewarm responses and actions taken during that period.

My comments today are focused largely on our latest review and the April 2011 report. This was the second annual JSF report under our current mandate in the National Defense Authorization Act for Fiscal Year 2010.[3] For that report, we (1) evaluated program cost and schedule changes and their implications on affordability; (2) identified progress made in 2010 against established goals; (3) assessed elements of design stability and manufacturing maturity and reviewed production results; and (4) reported the status of development testing and technical challenges facing the program. To conduct this work, we evaluated DOD's restructuring actions and impacts on the program, tracked cost and schedule changes, and determined factors driving the changes. We reviewed program status reports, manufacturing data, test plans, and internal DOD analyses. We discussed results to date and future plans to complete JSF development and move further into procurement with officials from DOD, the JSF

[2] GAO, *Joint Strike Fighter: Restructuring Places Program on Firmer Footing, but Progress Still Lags*, GAO-11-325 (Washington, D.C.: Apr. 7, 2011). Refer to the related products section for a complete list of GAO reports and testimonies.

[3] Pub. L. No. 111-84, § 244 (2009).

program office, contractor officials, and members of the independent review teams. We toured aircraft and engine manufacturing plants, obtained production and supply performance indicators, and discussed improvements underway with contractors. We conducted this performance audit from May 2010 to March 2011 in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives.

JSF Restructuring Improves Program, but Affordability Is Challenged by Rising Costs and Delays

DOD has substantially restructured the JSF program over the past 15 months, taking positive actions that should lead to more achievable and predictable outcomes. Restructuring has consequences—higher development costs, fewer aircraft in the near term, training delays, and extended times for testing and delivering capabilities to warfighters. Key restructuring changes include the following:

- The total system development cost estimate rose to $56.4 billion and its schedule was extended to 2018. This represents a 26 percent increase in cost and a 5-year slip in schedule compared to the current approved program baseline established in 2007.
- Resources and time were added to development testing. Testing plans were made more robust by adding another development test aircraft and the use of several production aircraft; increasing the number of test flights by one-third; extending development testing to 2016; and reducing its overlap with initial operational testing.
- Near-term procurement quantities were reduced by 246 aircraft through 2016; the annual rate of increase in production was lowered; and the start of full-rate production moved to 2018, a 5-year slip from the current baseline.
- The military services were directed to reexamine their initial operational capability (IOC) requirements, the critical need dates when the warfighter must have in place the first increment of operational forces available for combat. We expect the Marine Corps' IOC will slip significantly from its current 2012 date and that the Air Force's and Navy's IOC dates will also slip from the current dates in 2016.
- To address technical problems and test deficiencies for the Marine Corps' STOVL variant, the department significantly scaled back its procurement quantities and directed a 2-year period for evaluating and engineering technical solutions to inform future decisions on this variant. DOD also

"decoupled" STOVL testing from the other two variants so as not to delay them and to allow all three to proceed at their own speeds.

The fiscal year 2012 Defense Budget reflects the financial effects from restructuring actions through 2016. Compared to estimates in the fiscal year 2010 future years defense program for the same 5-year period, the department increased development funding by $7.7 billion and decreased procurement funding by $8.4 billion reflecting plans to buy fewer aircraft. Table 1 summarizes the revised funding requirements and annual quantities following the Secretary's reductions. Even after decreasing near-term quantities and lowering the annual rate of increase in production, JSF procurement still escalates significantly. Annual funding levels more than double and quantities more than triple during this period. These numbers do not include the additional orders expected from the international partners.

Table 1: Proposed Development and Procurement Funding and Quantities for Fiscal Years 2012-2016

Dollars in billions						
Development funding	**2012**	**2013**	**2014**	**2015**	**2016**	**Total**
Air Force (CTOL)	$1.4	$1.2	$0.9	$0.6	$0.4	**$4.5**
Navy (CV)	0.7	0.7	0.7	0.6	0.5	**$3.2**
Marine Corps (STOVL)	0.7	0.7	0.7	0.6	0.5	**$3.2**
U.S. total	**$2.7**	**$2.7**	**$2.3**	**$1.8**	**$1.3**	**$10.8**
Procurement funding						
Air Force (CTOL)	$3.8	$4.1	$5.6	$6.5	$8.5	**$28.5**
Navy (CV)	1.8	2.5	2.8	3.3	2.9	**13.2**
Marine Corps (STOVL)	1.3	1.3	1.4	2.0	2.9	**9.0**
U.S. total	**$6.9**	**$7.9**	**$9.8**	**$11.8**	**$14.3**	**$50.7**
Procurement Quantities						
Air Force (CTOL)	19	24	40	50	70	**203**
Navy (CV)	7	12	14	19	20	**72**
Marine Corps (STOVL)	6	6	8	12	18	**50**
U.S. total	**32**	**42**	**62**	**81**	**108**	**325**

Source: GAO analysis of fiscal year 2012 President's Budget.

Note: Numbers may not add due to rounding.

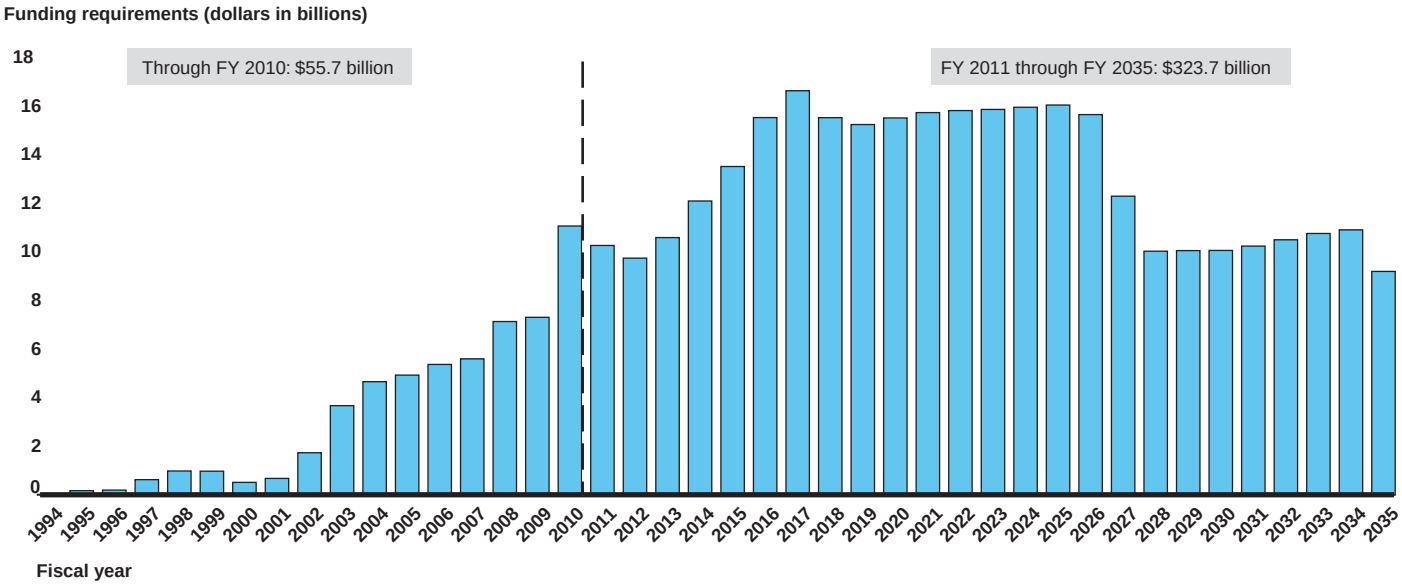
At the time of our review, DOD did not yet know the full impact from restructuring actions on future procurement funding requirements beyond this 5-year period. Cost analysts were still calculating the net effects from deferring the near-term procurement of 246 aircraft to future years and

from lowering the annual rate of increased procurement. After a Nunn-McCurdy breach of the critical cost growth threshold and DOD certification, the most recent milestone must be rescinded, the program restructured to address the cause of the breach, and a new acquisition program baseline must be approved that reflects the certification approved by the milestone decision authority. The Secretary has not yet granted new milestone B approval for the JSF nor approved a new acquisition program baseline; officials expect to do so next month. We expect future funding requirements will be somewhat higher than currently projected. This could reduce the quantities considered affordable by the U.S. and allies, further driving up unit costs.

Affordability—in terms of the investment costs to acquire the JSF, the continuing costs to operate and maintain it over the life-cycle, and its impact on other defense programs—is a challenging issue. Including the funding added by the restructuring actions, system development cost estimates have increased 64 percent since program start. (Appendix III summarizes the increases in target prices and major cost drivers for the air system and primary engine development contracts.) Also, the estimated average unit procurement price for the JSF has about doubled since program start and current forecasts indicate that life-cycle costs will be substantially higher than the legacy aircraft it replaces. Rising JSF costs erode buying power and may make it difficult for the U.S. and its allies to buy and sustain as many aircraft as planned.

Going forward, the JSF will require unprecedented demands for funding in a period of more austere defense budgets where it will have to annually compete with other defense and nondefense priorities for the discretionary federal dollar. Figure 1 illustrates the substantive annual development and procurement funding requirements—almost $13 billion on average through program completion in 2035. This reflects the program's estimate at the time of the fiscal year 2012 budget submission. As discussed earlier, defense cost analysts are still computing the long-term procurement funding requirements reflecting the deferral of aircraft to future years.

Figure 1: JSF Annual Development and Procurement Funding Requirements (April 2011 Estimate)



Source: GAO analysis of DOD data.

Progress in Achieving the JSF Program's 2010 Goals Was Mixed

The JSF program established 12 clearly stated goals in testing, contracting, and manufacturing for completion in calendar year 2010. It had mixed success, achieving 6 goals and making varying degrees of progress on the other 6. For example, the program exceeded its goal for the number of development flight tests but did not deliver as many test and production aircraft as planned. Also, the program awarded its first fixed-price contract on its fourth lot of production aircraft, but did not award the fixed-price engine contract in 2010 as planned. Table 2 summarizes JSF goals and accomplishments for 2010.

Table 2: JSF Progress on Stated Goals for 2010

Key event	Achieved in 2010?	Status
Complete 400 development flight tests	Yes	Completed 410 test flights
First vertical landing of STOVL variant	Yes	Achieved March 2010
Carrier variant first flight	Yes	Achieved June 2010
Autonomic logistic information system is operational	Yes	Began limited operations July 2010
Training for 125 maintenance personnel completed	Yes	Trained 138 maintenance personnel
Award contract for fourth aircraft production lot	Yes	Awarded contract November 2010
Eleven test aircraft delivered to test sites	No	Delivered eight aircraft
Flight test rate of 12 flights per aircraft per month demonstrated	No	Achieved flight test rate of 2 to 8 per month
At least 3 aircraft delivered to Eglin Air Force Base	No	None delivered, expected mid-2011
Begin flight training operations at Eglin Air Force Base	No	Expected September 2011
Block 1.0 software delivered to flight test	No	Delivered limited capability November 2010 with full capability expected June 2011
Award contract for fourth engine production lot	No	Awarded May 2011

Source: GAO analysis of DOD data.

Although still hampered by the late delivery of test aircraft to testing sites, the development flight test program significantly ramped up operations in 2010, accomplishing 3 times as many test flights as the previous 3 years combined. The Air Force CTOL variant significantly exceeded the annual plan while initial limited testing of the Navy's CV variant was judged satisfactory, below plans for the number and hours of flight but ahead on flight test points[4] flown. The Marine Corps' STOVL, however, substantially underperformed in flight tests, experienced significant down times for maintenance, and was challenged by several technical issues unique to this variant that could add to its weight and cost. The STOVL's problems were a major factor in the Secretary's decision to give the STOVL a 2-year period to solve engineering issues, assess impacts, and inform a future decision as to whether and how to proceed with this variant. Table 3 summarizes 2010 flight test results for each variant.

[4] Flight test points are specific, quantifiable objectives in flight plans that are needed to verify aircraft design and performance.

Table 3: Flight Test Performance in 2010

	Conventional takeoff and landing variant	Short takeoff and vertical landing variant	Carrier variant	Total
Flight tests				
Actual	171	212	27	**410**
Planned	112	251	31	**394**
Difference	59	(39)	(4)	**16**
Flight test hours				
Actual	290	286	41	**617**
Planned	202	409	56	**667**
Difference	88	(123)	(15)	**(50)**
Flight test points flown				
Actual	1373	1924	496	**3793**
Planned	1064	2438	270	**3772**
Difference	309	(514)	226	**21**

Source: GAO analysis of DOD data.

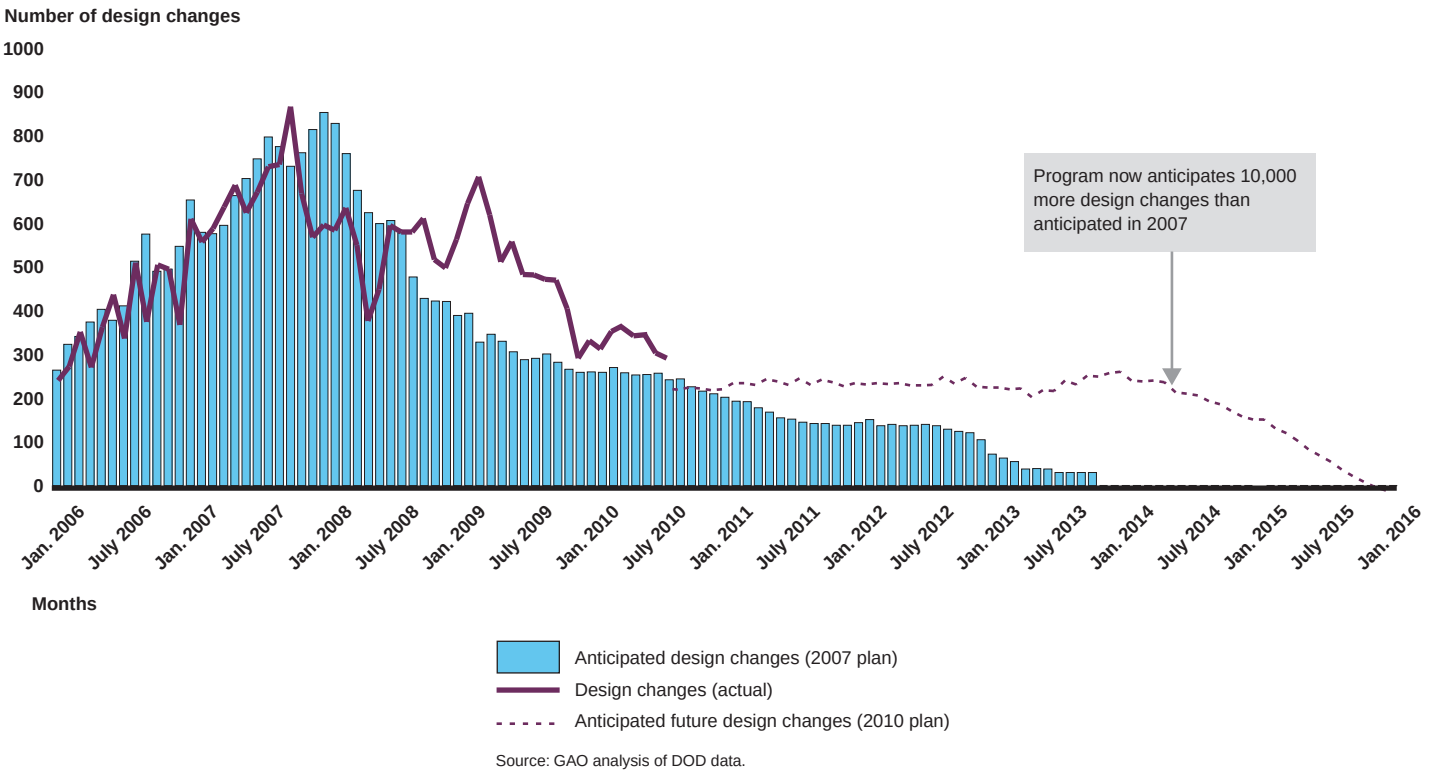
Program Has Still Not Fully Demonstrated a Stable Design and Mature Manufacturing Processes as It Enters Its Fifth Year of Production

After completing 9 years of system development and 4 years of overlapping production activities, the JSF program has been slow to gain adequate knowledge to ensure its design is stable and the manufacturing process is ready for greater levels of annual production. The JSF program still lags in achieving critical indicators of success expected from well-performing acquisition programs. Specifically, the program has not yet stabilized aircraft designs—engineering changes continue at higher than expected rates long after critical design reviews and well into procurement. Engineering drawings are still being released to the manufacturing floor. More changes are expected as testing accelerates. Also, manufacturing cost increases and delays in delivering test and production aircraft indicate a need for substantial improvements in factory throughput and performance of the global supply chain.

Engineering drawings released since design reviews and the number and rate of design changes exceed those planned at program outset and are not in line with best practices. Critical design reviews were completed on the three aircraft variants in 2006 and 2007 and the designs declared mature, but the program continues to experience numerous changes. Since 2007, the program has produced 20,000 additional engineering drawings, a 50-percent increase in total drawings and about five times more than best practices suggest. In addition, changes to drawings have not yet decreased and leveled off as planned. Figure 2 tracks and

compares monthly design changes and future forecasts against contractor plans in 2007.

Figure 2: Monthly Design Changes for JSF Aircraft



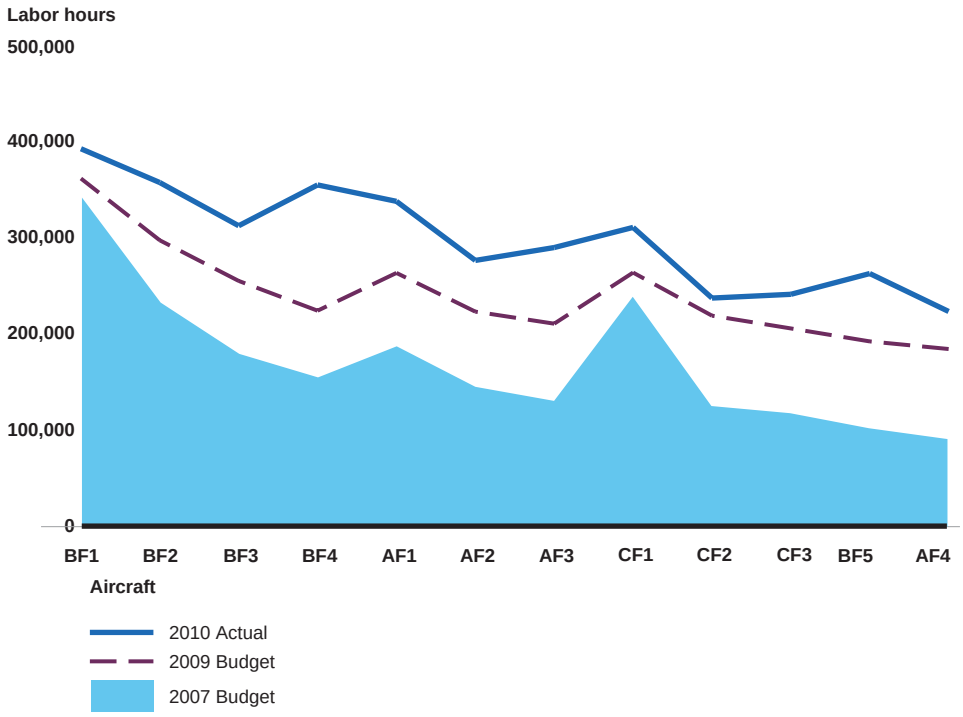
Source: GAO analysis of DOD data.

The monthly rate in 2009 and 2010 was higher than expected and the program now anticipates more changes over a longer period of time—about 10,000 more changes through January 2016. With most of development testing still ahead for the JSF, the risk and impact from required design changes are significant. In addition, emerging concerns about the STOVL lift fan and drive shaft, fatigue cracks in a ground test article, and stealth-related issues may drive additional and substantive design changes.

Manufacturing and delivering test jets took much more time and money than planned. As in prior years, lingering management inefficiencies,

including substantial out-of-station work[5] and part shortages, continued to increase the labor needed to manufacture test aircraft. Although there have been improvements in these factors, final acceptance and delivery of test jets were still delayed. Total labor hours required to produce the test aircraft increased over time. The cumulative actual labor hours through 2010 to complete the 12 test aircraft exceeded the budgeted hours estimated in 2007 by more than 1.5 million hours, a 75 percent increase. Figure 3 depicts forecasted and actual labor hours for building test jets.

Figure 3: JSF Labor Hours for Manufacturing Test Aircraft



Source: GAO analysis of DOD data.

DOD began procuring production jets in 2007 and has now ordered 58 aircraft on the first four low-rate initial production lots. The JSF program anticipated the delivery of 14 production aircraft through 2010, but none

[5] Out of station work occurs when manufacturing steps are not completed at its designated work station and must be finished elsewhere later in production. This is highly inefficient, increasing labor hours, causing delays, and sometimes quality problems.

were delivered during that period. Delivery of the two production jets ordered in 2007 has been delayed several times since the contract was signed and the first aircraft was just delivered this month. The prices on each of the first three cost-reimbursable production contracts have increased from the amounts negotiated at contract awards and the completion dates for delivering aircraft have been extended over 9 months on average. We are encouraged by DOD's award of a fixed-price incentive fee contract for lot 4 production and the prospects for the cost study to inform lot 5 negotiations, but we have not examined contract specifications. Accumulating a large backlog of jets on order but undelivered is not an efficient use of federal funds, tying up millions of dollars in obligations ahead of the ability of the manufacturing process to produce.

The aircraft and engine manufacturers now have significantly more items in production flow compared to prior years and are making efforts to implement restructuring actions and recommendations from expert defense teams assembled to evaluate and improve production and supply operations. Eight of 20 key recommendations from the independent manufacturing review team have been implemented as of September 2010. Until improvements are fully implemented and demonstrated, the restructuring actions to reduce near term procurement quantities and establish a more achievable ramp rate are appropriate and will provide more time to fully mature manufacturing and supply processes and catch up with aircraft backlogs. Improving factory throughput and controlling costs—driving down labor and material costs and delivering on time— are essential for efficient manufacturing and timely delivery to the warfighter at the increased production rates planned for the future.

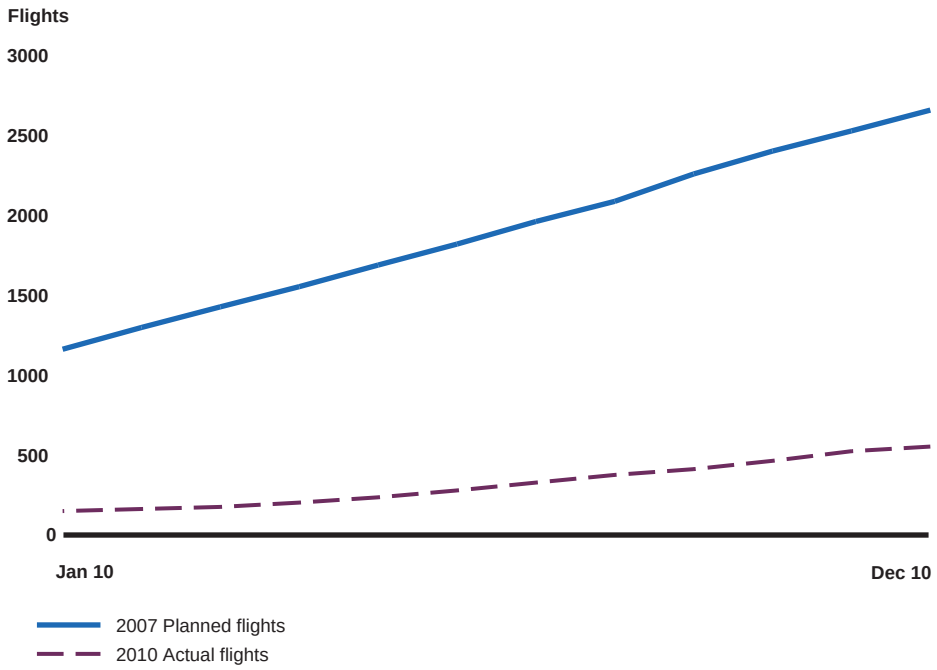
Testing Has Been Slow and Has Not Demonstrated That the Aircraft Will Work in Its Intended Environment

Since the first flight in December 2006, only about 4 percent of JSF capabilities have been completely verified by flight tests, lab results, or both. The pace of flight testing accelerated significantly in 2010, but overall progress is still much below plans forecasted several years ago. Furthermore, only a small portion of the extensive network of ground test labs and simulation models are fully accredited to ensure the fidelity of results. Software development—essential for achieving about 80 percent of the JSF functionality—is significantly behind schedule as it enters its most challenging phase.

Development flight testing was much more active in 2010 than prior years and had some notable successes, but cumulatively still lagged behind previous expectations. The continuing effects from late delivery of test

aircraft and an inability to achieve the planned flying rates per aircraft substantially reduced the amount and pace of testing planned previously. Consequently, even though the flight test program accelerated its pace last year, the total number of flights accomplished during the first 4 years of the test program significantly lagged expectations when the program's 2007 baseline was established. Figure 4 shows that the cumulative number of flights accomplished by the end of 2010 was only about one-fifth the numbers forecast by this time in the 2007 test plan.

Figure 4: Actual JSF Flight Tests Completed through 2010 Compared to the 2007 Plan



Source: GAO analysis of DOD data.

By the end of 2010, about 10 percent of more than 50,000 planned flight test points had been completed.[6] The majority of the points were earned on airworthiness tests (basic airframe handling characteristics) and in ferrying the planes to test sites. Remaining test points include more

[6] According to program officials completion of a test point means that the test point has been flown and that flight engineers ruled that the point has met the need. Further analysis may be necessary for the test point to be closed out.

complex and stringent requirements, such as mission systems, ship suitability, and weapons integration that have yet to be demonstrated.

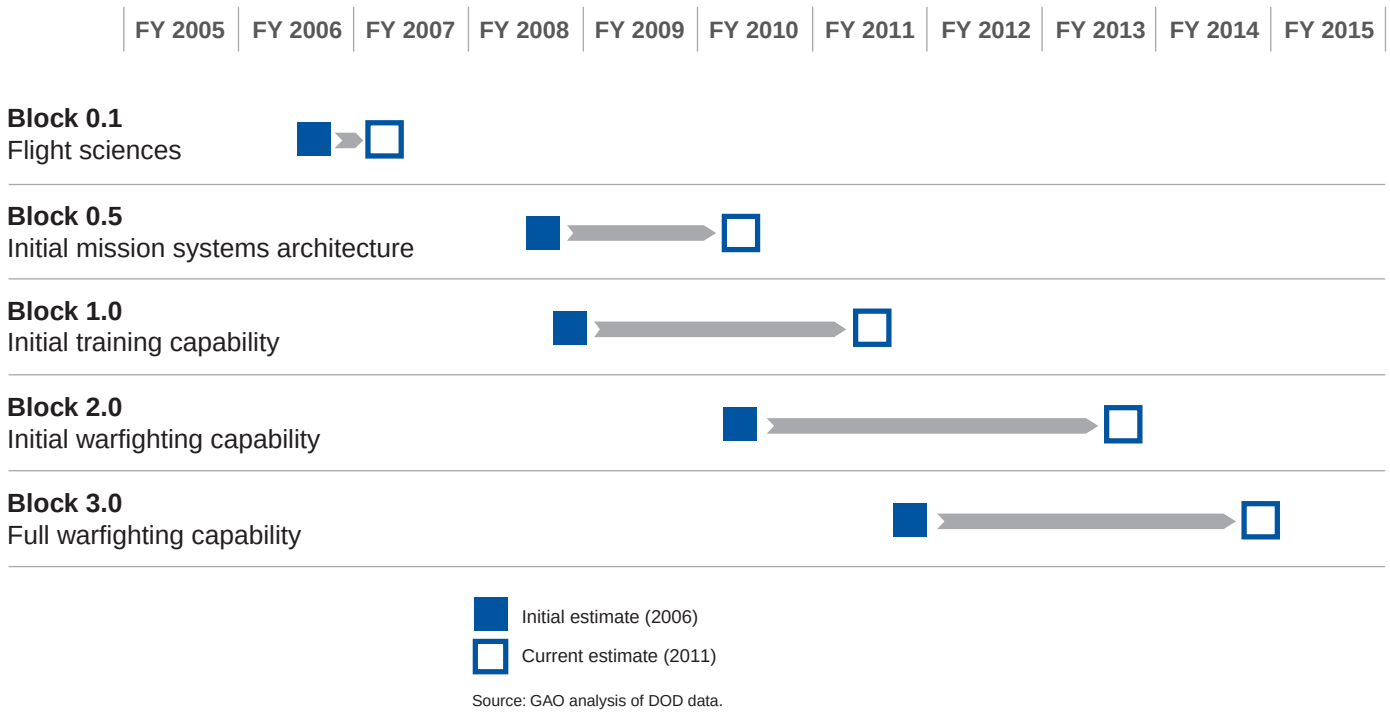
The JSF test program relies much more heavily than previous weapon systems on its modeling and simulation labs to test and verify aircraft design and subsystem performance. However, only 3 of 32 labs and models have been fully accredited to date. The program had planned to accredit 11 labs and models by now. Accreditation is essential to validate that the models accurately reflect aircraft performance and it largely depends upon flight test data to verify lab results. Moreover, the ability to substitute ground testing for some flight testing is unproven. Contractor officials told us that early results are providing good correlation between ground and flight tests.

Software providing essential JSF capability is not mature and releases to the test program are behind schedule. Officials underestimated the time and effort needed to develop and integrate the software, substantially contributing to the program's overall cost and schedule problems and testing delays, and requiring the retention of engineers for longer periods. Significant learning and development work remains before the program can demonstrate the mature software capabilities needed to meet warfighter requirements. The JSF software development effort is one of the largest and most complex in DOD history, providing functionality essential to capabilities such as sensor fusion, weapons and fire control, maintenance diagnostics, and propulsion. JSF has about 8 times more on-board software lines of code than the F/A-18E/F Super Hornet and 4 times for than the F-22A Raptor. While good progress has been reported on the writing of code, total lines of code have grown by 40 percent since preliminary design review and 13 percent since the critical design review. The amount of code needed will likely increase as integration and testing efforts intensify. A second software integration line added as part of the restructuring will improve capacity and output.

Delays in developing, integrating, and releasing software to the test program have cascading effects hampering flight tests, training, and lab accreditation. While progress is being made, a substantial amount of software work remains before the program can demonstrate full warfighting capability. The program released its second block, or increment, to flight test nearly 2 years later than the plan set in 2006, largely due to integration problems. Each of the remaining three blocks—providing full mission systems and warfighting capabilities—are now projected to slip more than 3 years compared to the 2006 plan. Figure 5

illustrates the actual and projected slips for each of the 5 software blocks in delivering software to the test program.

Figure 5: Slips in Delivering Software to Flight Test



Source: GAO analysis of DOD data.

Schedule delays require retention of engineering staff for longer periods of time. Also, some capabilities have been moved to future blocks in attempts to meet schedule and mitigate risks. Uncertainties pertaining to critical technologies, including the helmet-mounted display and advanced data links, pose risks for more delays.

Concluding Remarks

The JSF program is at a critical juncture—9 years in development and 4 years in limited production–but still early in flight testing to verify aircraft design and performance. If effectively implemented and sustained, the restructuring DOD is conducting should place the JSF program on a firmer footing and lead to more achievable and predictable outcomes. However, restructuring comes with a price—higher development costs, fewer aircraft received in the near term, training delays, prolonged times for testing and delivering the capabilities required by the warfighter, and

impacts on other defense programs and priorities. Reducing near-term procurement quantities lessens, but does not eliminate the still substantial and risky concurrency of development and production. Development and testing activities will now overlap 11 years of procurement. Flight testing and production activities are increasing and contractors are improving supply and manufacturing processes, but deliveries are still lagging. Slowed deliveries have led to a growing backlog of jets on order but not delivered. This is not a good use of federal funds, obligating millions of dollars well before the manufacturing process can deliver aircraft.

We agree with defense leadership that a renewed and sustained focus on affordability by contractors and the government is critical to moving this important program forward and enabling our military services and our allies to acquire and sustain JSF forces in needed quantities. Maintaining senior leadership's increased focus on program results, holding government and contractors accountable for improving performance, and bringing a more responsible management approach to the JSF to "live within its means" may help limit future cost growth and the consequences for other programs in the portfolio. The JSF acquisition demands an unprecedented share of the DOD's future investment funding. The program's size and priority are such that its cost overruns and extended schedules must either be borne by funding cuts to other programs or else drive increases in the top line of defense spending; the latter may not be an option in a period of more austere budgets. Given the other priorities that DOD must address in a finite budget, JSF affordability is critical and DOD must plan ahead to address and manage JSF challenges and risks in the future.

Chairman Levin, Ranking Member McCain, and members of the Senate Armed Services Committee, this completes my prepared statement. I would be pleased to respond to any questions you may have.

GAO Contacts and Acknowledgments

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Appendix I: Changes in Reported JSF Program Cost, Quantities, and Deliveries

	October 2001 (system development start)	December 2003 (replan)	March 2007 (approved baseline)	April 2010 (initial program restructure)	June 2010 (Nunn-McCurdy)
Expected quantities					
Development quantities	14	14	15	14	14
Procurement quantities (U.S. only)	2,852	2,443	2,443	2,443	2,443
Total quantities	**2,866**	**2,457**	**2,458**	**2,457**	**2,457**
Cost estimates (then-year dollars in billions)					
Development	$34.4	$44.8	$44.8	$50.2	$51.8
Procurement	196.6	199.8	231.7	277.5	325.1
Military construction	2.0	0.2	2.0	0.6	5.6
Total program acquisition	**$233.0**	**$244.8**	**$278.5**	**$328.3**	**$382.5**
Unit cost estimates (then-year dollars in millions)					
Program acquisition	$81	$100	$113	$134	$156
Average procurement	69	82	95	114	133
Estimated delivery and production dates					
First operational aircraft delivery	2008	2009	2010	2010	2010
Initial operational capability	2010-2012	2012-2013	2012-2015	2012-2016	TBD
Full-rate production	2012	2013	2013	2016	2016

Source: GAO analysis and DOD data.

Note: Does not reflect cost and schedule changes from additional restructuring actions announced since June 2010.

Appendix II: Prior GAO Reports on JSF and DOD Responses and Subsequent Actions

GAO report	Est. development cost & length, unit cost[a]	Key program event	Primary GAO message	DOD responses and actions
2001 GAO-02-39	$34.4 billion 10 years $69 million	Start of system development and demonstration approved.	Critical technologies needed for key aircraft performance elements are not mature. Program should delay start of system development until critical technologies are mature to acceptable levels.	DOD did not delay start of system development and demonstration stating technologies were at acceptable maturity levels and will manage risks in development.
2005 GAO-05-271	$44.8 billion 12 years $82 million	The program undergoes re-plan to address higher than expected design weight, which added $7 billion and 18 months to development schedule.	We recommended that the program reduce risks and establish executable business case that is knowledge-based with an evolutionary acquisition strategy.	DOD partially concurred but does not adjust strategy, believing that their approach is balanced between cost, schedule and technical risk.
2006 GAO-06-356	$45.7 billion 12 years $86 million	Program sets in motion plan to enter production in 2007 shortly after first flight of the non-production representative aircraft.	The program plans to enter production with less than 1 percent of testing complete. We recommend program delay investing in production until flight testing shows that JSF performs as expected.	DOD partially concurred but did not delay start of production because they believe the risk level was appropriate.
2007 GAO-07-360	$44.5 billion 12 years $104 million	Congress reduced funding for first two low-rate production buys thereby slowing the ramp up of production.	Progress is being made but concerns remained about undue overlap in testing and production. We recommend limits to annual production quantities to 24 a year until flying quantities are demonstrated.	DOD non-concurred and felt that the program had an acceptable level of concurrency and an appropriate acquisition strategy.
2008 GAO-08-388	$44.2 billion 12 years $104 million	DOD implemented a Mid-Course Risk Reduction Plan to replenish management reserves from about $400 million to about $1 billion by reducing test resources.	We believe new plan actually increases risks and DOD should revise the plan to address concerns about testing, use of management reserves, and manufacturing. We determine that the cost estimate is not reliable and that a new cost estimate and schedule risk assessment is needed.	DOD did not revise risk plan nor restore testing resources, stating that they will monitor the new plan and adjust it if necessary. Consistent with a report recommendation, a new cost estimate was eventually prepared, but DOD did not do a risk and uncertainty analysis that we felt was important to provide a range estimate of potential outcomes.

GAO report	Est. development cost & length, unit cost[a]	Key program event	Primary GAO message	DOD responses and actions
2009 GAO-09-303	$44.4 billion 13 years $104 million	The program increased the cost estimate and adds a year to development but accelerated the production ramp up. Independent DOD cost estimate (JET I) projects even higher costs and further delays.	Because of development problems, we stated that moving forward with an accelerated procurement plan and use of cost reimbursement contracts is very risky. We recommended the program report on the risks and mitigation strategy for this approach.	DOD agreed to report its contracting strategy and plans to Congress. In response to our report recommendation, DOD subsequently agreed to do a schedule risk analysis, but still had not done so as of February 2011. In February 2010, the department announced a major restructuring of the JSF program, including reduced procurement and a planned move to fixed-price contracts.
2010 GAO-10-382	$49.3 billion 15 years $112 million	The program was restructured to reflect findings of recent independent cost team (JET II) and independent manufacturing review team. As a result, development funds increased, test aircraft were added, the schedule was extended, and the early production rate decreased.	Because of additional costs and schedule delays the program's ability to meet warfighter requirements on time is at risk. We recommend the program complete a full comprehensive cost estimate and assess warfighter and IOC requirements. We suggest that Congress require DOD to prepare a "system maturity matrix" - a tool for tying annual procurement requests to demonstrated progress.	DOD continued restructuring actions and announced plans to increase test resources and lower the production rate. Independent review teams evaluated aircraft and engine manufacturing processes. As we projected in this report, cost increases later resulted in a Nunn-McCurdy breach. Military services are currently reviewing capability requirements as we recommended. The department and Congress are working on a "system maturity matrix" tool to improve oversight and inform budget deliberations.

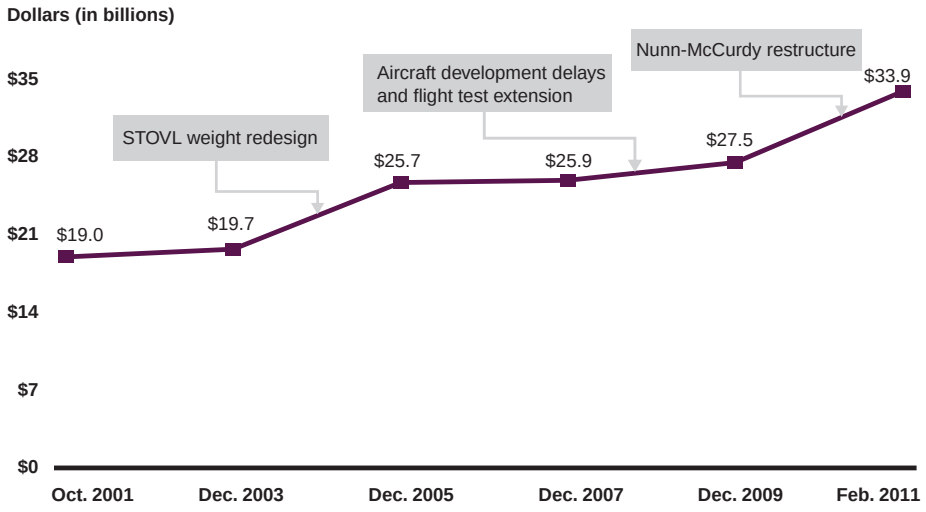
Source: DOD data and GAO analysis.

[a] Average procurement unit cost.

Appendix III: System Development Contracts Target Price Changes

Projected development costs for the air system and primary engine comprise nearly 80 percent of total system development funding requirements. Both contracts have experienced significant price increases since contract awards—79 percent and 69 percent respectively. Figures 6 and 7 depict the price histories for these contracts and the reasons behind major price increases.

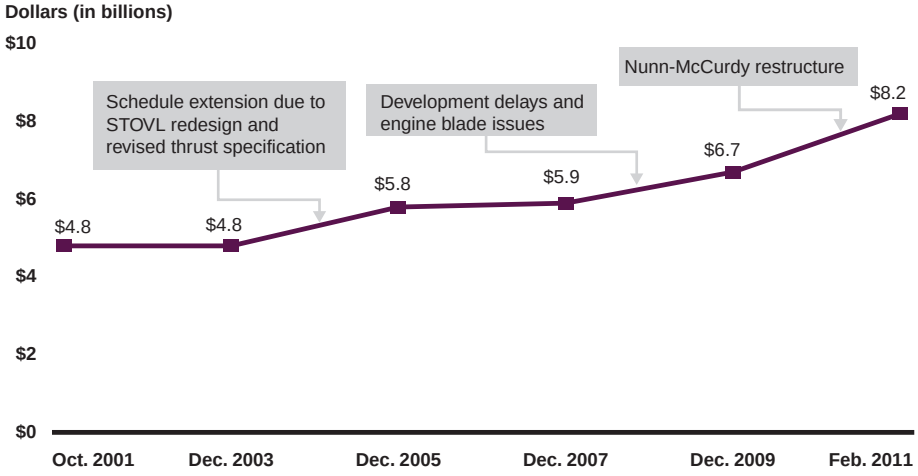
Figure 6: JSF Air System Development Contract Target Price Increases



Source: GAO analysis of DOD data.

Note: The February 2011 cost is not the contract target price, but the latest government estimate from the fiscal year 2012 defense budget request.

Figure 7: Primary Engine Development Contract Target Price Increases



Source: GAO analysis of DOD data.

Note: The February 2011 cost is not the contract target price, but the latest government estimate from the fiscal year 2012 defense budget request.

Related GAO Products

Joint Strike Fighter: Restructuring Places Program on Firmer Footing, but Progress Still Lags. GAO-11-325. Washington, D.C.: April 7, 2011.

Joint Strike Fighter: Restructuring Should Improve Outcomes, but Progress Is Still Lagging Overall. GAO-11-450T. Washington, D.C.: March 15, 2011.

Tactical Aircraft: Air Force Fighter Force Structure Reports Generally Addressed Congressional Mandates, but Reflected Dated Plans and Guidance, and Limited Analyses. GAO-11-323R. Washington, D.C.: February 24, 2011.

Defense Management: DOD Needs to Monitor and Assess Corrective Actions Resulting from Its Corrosion Study of the F-35 Joint Strike Fighter. GAO-11-171R. Washington D.C.: December 16, 2010.

Joint Strike Fighter: Assessment of DOD's Funding Projection for the F136 Alternate Engine. GAO-10-1020R. Washington, D.C.: September 15, 2010.

Tactical Aircraft: DOD's Ability to Meet Future Requirements is Uncertain, with Key Analyses Needed to Inform Upcoming Investment Decisions. GAO-10-789. Washington, D.C.: July 29, 2010.

Defense Acquisitions: Assessments of Selected Weapon Programs. GAO-10-388SP. Washington, D.C.: March 30, 2010.

Joint Strike Fighter: Significant Challenges and Decisions Ahead. GAO-10-478T. Washington, D.C.: March 24, 2010.

Joint Strike Fighter: Additional Costs and Delays Risk Not Meeting Warfighter Requirements on Time. GAO-10-382. Washington, D.C.: March 19, 2010.

Joint Strike Fighter: Significant Challenges Remain as DOD Restructures Program. GAO-10-520T. Washington, D.C.: March 11, 2010.

Joint Strike Fighter: Strong Risk Management Essential as Program Enters Most Challenging Phase. GAO-09-711T. Washington, D.C.: May 20, 2009.

Defense Acquisitions: Assessments of Selected Weapon Programs. GAO-09-326SP. Washington, D.C.: March 30, 2009.

Joint Strike Fighter: Accelerating Procurement before Completing Development Increases the Government's Financial Risk. GAO-09-303. Washington D.C.: March 12, 2009.

Defense Acquisitions: Better Weapon Program Outcomes Require Discipline, Accountability, and Fundamental Changes in the Acquisition Environment. GAO-08-782T. Washington, D.C.: June 3, 2008.

Defense Acquisitions: Assessments of Selected Weapon Programs. GAO-08-467SP. Washington, D.C.: March 31, 2008.

Joint Strike Fighter: Impact of Recent Decisions on Program Risks. GAO-08-569T. Washington, D.C.: March 11, 2008.

Joint Strike Fighter: Recent Decisions by DOD Add to Program Risks. GAO-08-388. Washington, D.C.: March 11, 2008.

Tactical Aircraft: DOD Needs a Joint and Integrated Investment Strategy. GAO-07-415. Washington, D.C.: April 2, 2007.

Defense Acquisitions: Assessments of Selected Weapon Programs. GAO-07-406SP. Washington, D.C.: March 30, 2007.

Defense Acquisitions: Analysis of Costs for the Joint Strike Fighter Engine Program. GAO-07-656T. Washington, D.C.: March 22, 2007.

Joint Strike Fighter: Progress Made and Challenges Remain. GAO-07-360. Washington, D.C.: March 15, 2007.

Tactical Aircraft: DOD's Cancellation of the Joint Strike Fighter Alternate Engine Program Was Not Based on a Comprehensive Analysis. GAO-06-717R. Washington, D.C.: May 22, 2006.

Defense Acquisitions: Major Weapon Systems Continue to Experience Cost and Schedule Problems under DOD's Revised Policy. GAO-06-368. Washington, D.C.: April 13, 2006.

Defense Acquisitions: Actions Needed to Get Better Results on Weapons Systems Investments. GAO-06-585T. Washington, D.C.: April 5, 2006.

Tactical Aircraft: Recapitalization Goals Are Not Supported by Knowledge-Based F-22A and JSF Business Cases. GAO-06-487T. Washington, D.C.: March 16, 2006.

Joint Strike Fighter: DOD Plans to Enter Production before Testing Demonstrates Acceptable Performance. GAO-06-356. Washington, D.C.: March 15, 2006.

Joint Strike Fighter: Management of the Technology Transfer Process. GAO-06-364. Washington, D.C.: March 14, 2006.

Tactical Aircraft: F/A-22 and JSF Acquisition Plans and Implications for Tactical Aircraft Modernization. GAO-05-519T. Washington, D.C: April 6, 2005.

Tactical Aircraft: Opportunity to Reduce Risks in the Joint Strike Fighter Program with Different Acquisition Strategy. GAO-05-271. Washington, D.C.: March 15, 2005.

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